Reimagining the academic library: What to do next. Review article

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Abstract

This article reviews the conclusions of the author's 2016 book, *Reimagining the academic library* and considers changes in scholarly communication and academic libraries that have taken place since its publication. Recommendations for alterations in the practice of individual libraries are provided. The problem of created integrated community-controlled open infrastructure is considered at length, especially the collective action problem that the library community must overcome.

Keywords

Academic libraries; Academic library futures; Scholarly communications infrastructure; Collective action problem; Open scholarly commons; Literature review.

1. Introduction

In May of 2016, my book, *Reimagining the academic library*, was published (**Lewis**, 2016). I finished the writing it sometime in the late fall of 2015. Over three years has passed since then and in those three years there have been significant changes to the world of scholarly communication and academic libraries. In this paper I will review the main points of my book in light of what has happened in the last three years, and lay out what I believe is required of academic libraries going forward.

To do this I will use the structure of the book's concluding chapter, "Conclusion: Ten things to do now."

As was the case with my book, my perspective will be primarily from the United States as this is what I know best. I will though endeavor to include perspectives and developments from other parts of the world.

2. The world we want: The open scholarly commons

To start, it is important to consider the goal. For me the goal is clear. We, the library community and others, need to create the open scholarly commons. We need to create a world where all scholarship and all of the world's cultural heritage is discoverable, openly available to everyone in the world, and preserved for future generations.

Doing so means that academic libraries will need to flip what they do. In the past they were primarily concerned with bringing knowledge from the world to their institutions or communities. In the future their focus needs to be on making the knowledge produced in or of interest to their institutions or communities available to the world by making it discove-

rable, accessible, and preserving it. This part individual libraries can do on their own. This flip was a major focus of my book. It is what Lorcan Dempsey has called moving from the "outside-in" library to the "inside-out" library (**Dempsey**, 2016). Libraries will be joined by museums and other cultural heritage organizations that will provide additional content. Government agencies, scholarly societies, and foundations will also contribute. The holders and stewards of the world's knowledge need to make it available to the world.

> "Academic libraries will need to flip what they do"

But for this work to have impact it needs to be paired with the collective creation of open integrated community-controlled infrastructure to bring all of the separate local contributions together to create a comprehensive world-wide resource. Jean-Claude Guédon describes the combination this way:

> "In the end, libraries can point out the fact that their future role actually points in two, apparently opposite, yet deeply complementary directions: on the one hand, they plunge deeply into the local production scenes since they aim at systematically sweeping, storing, preserving, and curating all that is produced in their hosting institution; at the same time, the libraries, with their sister institutions, are involved in the task of ensuring a vibrant knowledge-nurturing life for their documents: they will circulate, be discoverable, be interoperable, be evaluated, etc. With the first function, each library ensures it safe and strong function within its host institution; with the second function, the libraries connect to bring the knowledge infrastructure that we all really need" (**Guédon**, 2017).

What has become clearest to me in the past three years is that what is most important is not changing individual libraries, which was what I was focused on in my book. Changing individual libraries will matter, but the most important issue is the need for collective action to create the open integrated community-controlled infrastructure needed to support the open scholarly commons. As Alejandro Posada and George Chen put it after reviewing the monopoly tactics of the large commercial journal publishers, particularly *Elsevier* and *Wiley*,

> "To ensure the global resolutions of inequalities in discourse and scholarly representation there is thus a clear need for a community-driven integration of scholarly infrastructure, one that is aware of the potential of inequality preparation within the community rather than one which only seeks to add value and co-opt the process for the objective of rent" (**Posada**; **Chen**, 2018).

Library's contribution to funding such infrastructure was my book's ninth thing to do. Both creating and funding the infrastructure will be discussed at length below. It is quite clear that without robust infrastructure the content we all curate will be less useful and our efforts much less effective.

In attempting to create the open scholarly commons we face many challenges as the vested interests that currently dominate the scholarly communications ecosystem are well resourced and will not easily give up their positions of profit and control. Librarians as a profession, are often overly timid and we are too often unwilling to abandon the long-established practices we have carried with us from the print era. We also too often underestimate the resources we control and our ability to be the masters of our own fate. I am however optimistic. I believe that there are three fundamentals that work in our favor.

> "Librarians too often underestimate the resources they control and their ability to be the masters of their own fate"

2.1. Fundamental one: The money flows through academic libraries

Most of the money that funds scholarly communications flows through academic libraries. The most recent figures from 2014 put the total budgets for all U.S. academic libraries at over $8 billion with more $3 billion being spent on content and preservation (*Almanac*, 2018). This is a lot on money.

From an economic perspective the most efficient way to provide scholarly content requires subsidy. When costs are passed on to users, the content is not used to the extent that would provide the most societal benefit. Understanding this, institutions and communities created libraries to provide content free of charge to users. One of the key questions we face today is: given the changes in technologies, are libraries the best way to use the subsidy? The key thing to understand is that today the subsidy comes to the library and in general libraries are trusted to use the subsidy wisely. That is, libraries have the money and the ability to spend it.

In most cases libraries don't think of themselves as well-resourced because they have established commitments for all to their budgets and then some. The excessive cost increases of journals published by the large commercial publishers has exacerbated these budget pressures. What is often not considered is the opportunity cost of these commitments. Libraries have it within their power to redirect their budgets should they choose to do so. There are of course challenges in changing practice, not the least of these being our own reluctance to take risks and the general conservatism of the academy and faculty who are reluctant to change their practice, but should we choose to do so, redirecting our resources is an option. The example of the German and Swedish negotiations with *Elsevier* demonstrate that when the groundwork is done this is possible.

2.2. Fundamental two: The nature of digital content on the network is different from print

In the print world the economics of scholarly communication were based on scarcity and ownership, and too often monopoly control and monopoly rent taking. In the early digital world publishers, particularly large commercial and society publishers, carried over the practices from print as they generated significant profits. But digital content on the Web is very different from paper-based content. It has the following characteristics:

- A copy can be instantaneously delivered anywhere in the world.
- A copy is the same as the original.
- A copy can be made at zero marginal cost.

That is to say, as Andrew McAfee and Erik Brynjolfsson do, digital content should be, "Free, perfect and instant" (**McAfee**; **Brynjolfsson**, 2017, pp. 135-137).

This is how it can and should be, but as we all know this is not how it yet is. We can though see it moving in this direction. Information may not want to be free, but the economics argue that it should be as cheap as possible. Economics also argues that the most efficient way to deliver digital content is not by charging the user, or the user's library. Rather the most efficient way is to cover the first copy cost in some way and then distribute the content to users at no cost. That is theoretically the most economically efficient business model is open access. I have described in some detail why gold open access journals are more efficient and why they are likely to disrupt the subscription-based journal model (**Lewis**, 2012). Good data on the extent to which open access publishing has grown and what portion of the published literature is open access today has not been consistently collected, but a recent methodological strong study by Heather Piwowar and her colleagues suggests that about 50% of the journal literature published in 2015 was in one way or another open access (**Piwowar** *et al.*, 2018). The growth of open access is shown in Figure 1 from their study.

> "When costs are passed on to users, the content is not used to the extent that would provide the most societal benefit"

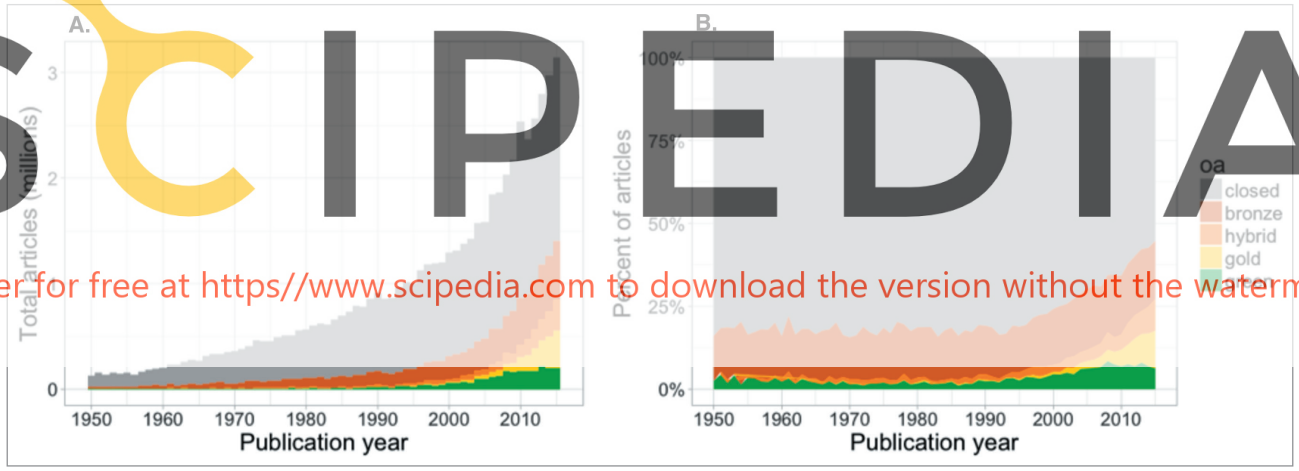


Figure 1. Total and % of articles available in open access 1950-2010 (**Piwowar** *et al.*, 2018)
https://peerj.com/articles/4375/#fig-2

If open access is the most efficient business model for publishing scholarly content on the network then the trends we have seen to date will continue, and, I believe, they will accelerate. Economics tells us that when the margin cost of an item is zero, and as noted above the margin cost of digital content on the network is zero, then the price that will maximize social good is zero. This of course means that the funding of the first copy cost and the cost of infrastructure need to be covered in some way besides sales of the content. This in turn means that subsidies are required, usually provided with taxes of some sort. How to accomplish this is a key piece of the problem we face. The important flip side of this is that when the cost to cover the first copy cost and the cost of infrastructure are passed on to users of the content, there is a significant dead weight loss. This means that societal benefit that should have accrued did not. Users who could have benefited from the content would not or could not pay to use it, and so the uses they might have made of the content did not get made. Scholarship and science slow, and society loses as a result.

Sci Hub exists, at least in part, because the dead weight loss in the current economics of scholarly communications is clear and in the minds of many justifies the seemingly petty theft that *Sci Hub* enables. Thus, we have what has sometimes has been call "Robinhood OA."

2.3. Fundamental three: Moore's law and cost reduction

We also need to recognize that Moore's Law is not going away, at least not any time soon. Technically, Moore's Law predicts

the number of transistors that can be put onto an integrated circuit chip. But Moore's Law is part of the larger phenomenon of digitization. Ray Kurzweil looked at earlier digital technologies and when he did it became clear that Moore's Law is really the continuation of a trend that began with the first use of digital technology on electromechanical devices, like punched cards, in the late 19th century (**Kurzweil**, 2010). It is important to recognize that the change Moore observed was not really about transistors on silicon, rather it was about representing information with ones and zeros so that machines could process it. Using machines to manage information began over 125 years ago and the capacity of this machine processing continues to grow at an accelerating rate.

> "The most efficient way to deliver digital content is to cover the first copy cost in some way and then distribute the content to users at no cost"

If we generalize Moore's Law to say that the capacity of digital technology doubles every 18 months, then in a decade that capacity increases 100 times. But this might understate the extent of the change. The chart below is from the *U.S. National Institutes of Health* and shows the decrease in the cost of sequencing a human genome (**Wetterstrand**, 2017). Note that this chart is on a log scale. The white line is the price decrease we would expect from improvements based on Moore's Law. We would have expected a decline in the price between 2000 and 2017 of two orders of magnitude. In fact, the decline was five orders of magnitude from nearly $100 million in 2000 to about $1,000 in 2017. If we translate this into "library units", this is the difference between building a good-sized university library and purchasing a dozen books.

So, how do we think about Moore's Law and the increasing capacity of technology? One way is to ask the economic question posed by Ajay Agrawal who says, when talking about artificial intelligence,

> "When looking at artificial intelligence from the perspective of economics, we ask the same, single question that we ask with any technology: What does it reduce the cost of?" (**Agrawal**, 2018).

Artificial intelligence says Agrawal reduces the price of prediction. Computing Agrawal argues reduces the price of arithmetic. Because price of arithmetic has decrease at the rate of Moore's Law for several decades, we can now do things with arithmetic that don't seem at all like arithmetic problems —like music or photography. As prediction gets cheap we can do things with prediction that don't seem like prediction problems, like self-driving cars, or maybe peer review. The later possibility is suggested by *Meta*, a machine learning system, with what the developers call *Bibliometric Intelligence*. As they state in a white paper,

> "The results of this large-scale trial demonstrate that *Meta* is able to perform 2.7x better than the best baseline estimator at predicting article-level impact for new manuscripts prior to publication. Additionally, it performed 2x better than the baseline at identifying 'superstar articles' –those that represent the top 1% of high impact papers, prior to publication" (**Yang** *et al.*, 2016, p. 6; *Aries Marketing*, 2016).

The baseline estimator was expert reviewers. Today this system is being marketed to journals to do preliminary screening of manuscripts and to match manuscripts to the most appropriate journal.

In the library world *Google* reduces the price of searching, the Web and digital documents on it, as we noted above, reduces the price of publishing. As Clay Shirky has said,

> "It makes increasingly less sense even to talk about a publishing industry, because the core problem publishing solves —the incredible difficulty, complexity, and expense of making something available to the public— has stopped being a problem" (**Shirky**, 2009).

Shirky likely overstates the case as there are still first copy costs in the academic publishing, but the technology should certainly reduce them. *Amazon* has reduced the cost and time needed to acquire physical objects, most importantly for us, books.

So, the cost of many of the inputs to the scholarly communication system and academic libraries are being reduced and this should create the opportunities to reduce the cost or increase the quality of what we do. In my view, these three fundamental changes will allow academic libraries collectively to reimagine and revise their practice and in doing so create the open scholarly commons.

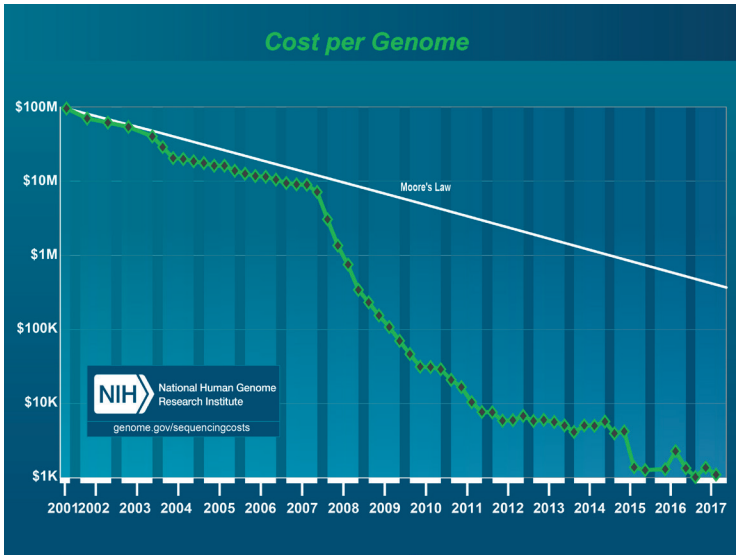


Figure 2. Decrease in the cost of sequencing a human genome (**Wetterstrand**, 2017)
https://www.genome.gov/images/content/costpergenome_2017.jpg

That there is some wind at our backs does not necessarily mean that it will be smooth sailing. There are several real problems that must be faced and overcome. The three most important and difficult are:

> Economic tells us that when the margin cost of an item is zero then the price that will maximize social good is zero

- the general difficulty of creating infrastructure;
- the difficulty of combating monopoly rent taking by for-profit publishers given the current intellectual property regime; and
- the collective action problem that makes it very difficult for large groups to act together, even when it is in their own interest.

These problems will be addressed at some length later in the article.

3. Nine of the ten things to do now

3.1. Nine of ten introduction

Nine on the ten things I suggested in my book that needed doing had to do with how an individual library should change its practice. As we review them I would encourage you to keep the end goal in mind. Each library is doing its part to create a world-wide resource. In doing so we serve our institutions, but in a way that is different than it was in the past. We need to learn to tell a new story about the value of libraries and about the importance of this work.

As I did with my book, I want to start with an assertion.

> "Libraries have always done three things:
>
> - They have kept documents for the long haul.
> - They have provided the knowledge and information that the communities and institutions that fund them need.
> - They have assisted individuals in finding and using information.
>
> They have done so to assure that communities and individuals are productive and so that civilizations are long-lasting" (**Lewis**, 2016, p. xi).

Many things change when content moves from print on paper to digital documents on the network, but these long-standing functions remain a good place to start in thinking about academic libraries in today.

First, the documents that will be kept for the long haul will mostly be locally produced by faculty and students or will be of special interest to the campus or the local community. Most, though not all, of these documents will be digital and most will be unique or special in some way. The responsibility for this content will include making it discoverable, primarily through network level tools, and preserving it.

Second, while the library will continue to purchase some content and make it available to students and faculty, much of the academic literature and much of the primary information that is the grist of research will be openly available on the Web, and so providing them to users will not be a library function. Rather the role of the library will be to assist researchers in making their work part of the open scholarly commons. This assistance will make the work available to all those who can benefit from it and thus will enhance the reputation of the researcher and that of the library's institution.

> The role of the library will be to assist researchers in making their work part of the open scholarly commons

Finally, the library will continue to assist users in finding and using information, but this will be not about using the local library. Rather it will mostly be about productively and ethically using that open scholarly commons that will large and complex.

I expect that for the foreseeable future there will be buildings called libraries. They will, as they are now, be in the middle of the campus and will be the primary non-classroom academic space on campus. They will in most case continue to house some paper book collections, especially special collections, but their primary role will be as a place for study and for librarians and other experts to meet with and assist students and faculty with a variety of tasks related to finding, using, and maybe most importantly creating information. Many of these experts will likely be called librarians and many will have traditional librarian credentials, though we can expect that both the titles of the experts and the training and credentials they bring to their positions will become more diverse.

3.2. One: Retire the legacy print collection now

We have known since the Kent study of the use of library materials at the *University of Pittsburgh* in 1979 that a large portion of the books in most academic libraries will never be used (**Kent**, 1979). We have also known since the Fussler and Simon study of book use at the *University of Chicago*, published in 1961, that the only reasonable predictor of future book use is past use (**Fussler**; **Simon**, 1961). Libraries have had for several decades an available strategy for culling books

from their collections and thus reducing the space need for collections. As Paul N. Courant and Matthew "Buzzy" Nielsen have shown this cost is not trivial. Their estimate was $4.26 per year in 2009 dollars (**Courant**; **Nielsen**, 2010, p. 91). Daniel Gore outlined this strategy in his 1976 well-reasoned essay "Farewell to Alexandria" (**Gore**, 1976), but no one paid any attention. At the time building large collections of unused books made some sense. Books, especially scholarly monographs, went out of print quickly and the ordering process and interlibrary loan were both slow. Buying and holding as many books as a library could afford was a good insurance policy against the possibility of use, even if that possibility was not large. It was also the case that the main measure of library quality was library size, so there was limited incentive to examine or change the practice on filling stacks with as many books as possible.

That was then. We are now in an environment where most scholarly work is available in digital form that is almost always acquirable instantaneously. Print book use is declining and print books are often available from *Amazon* or other providers in a day or two. Print-on-demand technology means that books don't go out of print. *GoogleBooks* and *HathiTrust* provide electronic access to most public domain books. This makes user-driven purchase strategies for both digital and print books a good option. Simply put, it means never again buying a book that will not be used by at least one person. In addition, interlibrary lending is much faster and easier. With *WorldCat* you can locate available copies of books across the world and *FedEx* or other delivery services can move them quickly and at reasonable cost. Only partly in jest I have suggested that libraries should allow users to select he titles they need for purchase and then the library would give the book to the user to save on the cost of storage (**Lewis**, 2010).

All of this means that countries or regions can begin to think of their library's collections as one, what Lorcan Dempsey and his colleagues have called the "collective collection." Their work suggests,

> "If the current growth trajectory of the *HathiTrust Digital Library* is sustained, we can project that more than 60% of the retrospective print collections held in *ARL*[1] libraries will be duplicated in the shared digital repository by June 2014."

For *ARL* libraries, there could be cost avoidance of $500,000 to $2 million per year and space savings of more than 45,000 assignable square feet could be achieved through shared print provision (**Dempsey**; **Lavoie**; **Malpas**, 2013, pp. 80-81).

For these savings to be achieved two things need to happen. First, there needs to be a national or regional strategy to assure that some appropriate number of use and preservation copies of all print books are preserved, preferably in high quality storage facilities. Second, individual libraries need to be prepared to deal with the potential objections of faculty who would be unhappy with the removal of books from their local library collections. Fortunately, at least in the United States, there is more than enough high-quality storage capacity. While somewhat dated, you can use the data on the capacity of storage facilities (**Payne**, 2007) and data on the number of book and copies of these books (**Lavoie**; **Schonfeld**, 2006) to demonstrate that the capacity to store the United States nation book collection exists (**Lewis**, 2016, p. 108).

OCLC's Sustainable Collection Services unit provides a service that many libraries and library consortiums have used to determine which books in their collections are not used and what other libraries hold them. Thus, it is possible for a library to identify a print book that is rarely used and that copies of it are available with dual rights, and then study has been done by a consortium, which partners will continue to hold the title. Several initiatives of this sort are already underway (**O'Gara**; **Osterman**, 2015; **Levenson**, 2015). This reduces the need to be overly concerned with faculty pushback on withdrawals as access to the withdrawn title can be assured. And, as we will see in the next section, the ability to repurpose library stacks when print volumes are removed is generally inexpensive way to acquire space.

3.3. Two: Develop a space plan

Academic library space is often the most valuable space on campus. It is generally centrally located. The building is generally open long hours. For most library building built after the Second World War, the space is often reasonably inexpensive to renovate. It is also the case that space is the most valuable resource on a university campus, so many people will propose many uses for "excess" library space.

Given the high value of space, it is important for the library to have a plan for the use of space as book stacks are removed. An important part of such a plan is the justification keeping the space in the library's hands. Such a justification is likely to have two parts. First, the library needs space for new services, especially those related to assisting faculty and students in creating and managing digital scholarly content. Second, on most campuses it should be possible to make a case for expanding student study space, both the variety of the space and the absolute number of seats. In my experience, making the second argument is more powerful as it ties the physical library to student academic success, which can be especially powerful on many campuses.

There is no doubt that libraries are special places on campus. Using methods drawn from the psychology of religion, Heather Lea Jackson and Trudi Bellardo Hahn make a case for the library as sacred space. As they put it,

> "This empirical study affirmed our hypothesis that spaces deemed as 'sacred' or 'sanctified' produce affective benefits for people that extend beyond attitudes and into the realm of behavior (projected library use). Circulation statistics do not measure these benefits; students may not actually use the books on the shelves, but they 'sanctify' the books —being around the books makes them feel more scholarly and connected to the institution's educational mission" (**Jackson**; **Hahn**, 2011, p. 436).

Academic libraries can be seen as "third spaces." The concept of "third spaces" comes from Ray Oldenburg's book *The great good place* (Oldenburg, 1989). Oldenburg describes a place between work and home that is neutral and informal, where everyone is welcome, but the tone and behavior expectations are set to be "regulars." Third space tend to be plane rather than flashy and the mood is often playful. I have argued that for students because the library has the characteristics of Oldenburgh's third space it becomes their home away from home (Lewis, 2017a, pp. 169-170).

There has been a push over the past decade or two to create space for group study in libraries and to add computers both for individual and group use. While they are expensive to build, where they exist, enclosed group study rooms are inevitably the most used space in the library, and often the most used space on campus. This push for group spaces is important, both because students are increasingly being give group assignments and they need somewhere to work together. There is also a trend for students to study alone in groups, each student doing their own work, but in the company of friends.

> "For students because the library has the characteristics of Oldenburgh's 'third space' it becomes their home away from home"

The design firm *Gensler* found, after a survey of over 1,200 students that while group study space is important, most students still look to the library for individual study. As the report on their study says, "While students report the library as a preferred space for both individual and group activities, their conception of the ideal library skews toward the solitary. Their top-ranked library qualities center around space to complete focused, individual work, and when asked what resources are most important to libraries today, 'quiet space for students' ranks first. When asked about the future, the rising importance of digital resources and connectivity becomes clear, while quiet space shows its continued importance" (*Gensler Research*, 2015, p. 3).

A number of other studies have similar findings (**Regalado**; **Smale**, 2015; **Applegate**, 2009).

The *Gensler Research* report makes three recommendations for designing library space:

- Focus on pragmatic, individual student needs.
- Don't sacrifice quiet in pursuit of collaboration.
- Integrate technology as a companion to traditional tools (*Gensler Research*, 2015).

The last recommendation means, at the very least, that you should put electrical outlets and USB ports everywhere you can.

An interesting study by John K. Stemmer and David M. Mahan provides a nuanced view of the impacts of library use, both of space and resources, on student academic success and how these relationships change over the course of an undergraduate's time at the university. While in most cases library use is positively correlated measures of student academic success, in some cases it is not. For example, studying in the library late at night is not (**Stemmer**; **Mahan**, 2016).

Given the need to stop spending money on books, libraries will need to make the very difficult decision to withdraw books are removed from the collection. There are any number of good studies that document both the impact of library space on student success and the best ways to design this space. It will be important for library leaders to begin making arguments based on these studies and of input from their own students, to campus leaders. This should begin before the books are gone so that when the time comes a strong case for the library's perspective on how the space should be used has been presented and hopefully the arguments accepted.

3.4. Three: Have a materials budget strategy to manage the transition from traditional publishing models to open access

The budget strategy of most libraries, to the extent that they have one at all, is to buy what they bought last year if they can, or more likely cover price increases of journal subscriptions by making whatever cuts they can manage.

This is far from what is currently required.

As has been discussed above, digital documents differ in important ways from their print predecessors. Library practice based on digital documents should and will soon differ as well. In order to make appropriate contributions to the open scholarly commons, individual libraries will need to change what they do and what they spend their money on. It is unreasonable to expect that universities will increase the funds they provide libraries so libraries will need to reallocate their existing budgets. They will need to stop spending as much as they now do to purchase content, particularly expensive commercially published science and technology journals, and move that money to supporting access, discovery, and preservation of locally produced content, supporting open access publishing though article processing fees and other means, and importantly supporting the development and maintenance of the infrastructure needed to support the commons. We will discuss the latter at length later in the article. For now, it is enough to know that together these expenditures will make up a sizable portion of a library's budget once the transition is complete. I speculated that today the infrastructure portion of this expenditure should be 2.5% of the library's total budget (**Lewis**, 2017c). I now believe that it is likely to need to be three to five times that at least, and it will have to grow at a noticeable rate in future years. In five to ten years I believe support for activities to develop the open scholarly commons will need to consume over half of library expenditures.

What is important now is to change the library's budget so that there is some surplus available today to invest in what will be important in the future. These funds only become available if libraries are aggressive in changing the way they spend their money. If libraries only make cuts only to match journal price increase there will be no surplus and no investment, and thus no escape from our current dependence on exploitive commercial publishers.

> "Given the value of space on every university campus, libraries need to make the case for using the space they create as book are removed from the collection"

Fortunately, changes in the market place for books and journal articles provide opportunities for the required cuts. I believe that the strategy that can be implemented by most libraries that will provide a surplus that can be invested in the kinds of initiatives need to move to an open scholarly commons. I have outlined this strategy in more detail in my book and in a 2013 article (**Lewis**, 2013; 2016). The strategy has four parts:

- Moving to a patron-drive acquisitions (PDA) model for book purchases.
- Purchase individual articles as an alternative to journal subscriptions.
- Replace subscriptions with open access.
- Replace databases with free web content.

The first two parts are critical and can be implemented by any library as a way of saving money. The latter two require that open content continues to become available and so libraries are dependent on developments that are largely beyond their direct control. However, libraries can be assertive in taking advantage of these developments as they occur. Let's now look at each part of the strategy in turn.

A patron-drive acquisitions (PDA) system for books involves loading records into the library's catalog for the books that the library is prepared to purchase, but not actually purchasing them until a user requests the book. This approach has been widely used for electronic books for nearly 20 years. For electronic books this strategy is particularly effective because delivery can be instantaneous. It can now also be reasonable applied to print books given the speed at which many titles can be attained from *Amazon* and other providers. Param Bedi and Jason Snyder document *Bucknell University*'s library adopted an exclusive PDA model for books. In two years, materials expenditures dropped nearly 75% and circulations remained constant (**Bedi**; **Snyder**, 2015). One approach would be for a library to use an approval plan as a way of selecting bibliographic records. It would also seem possible where there copies of both the electronic and print book are available and the print version is what the user wants to provide access to the electronic version immediately so the user has access to it for the several days the print book is in transit.

Purchasing articles as an alternative to journal subscriptions works when subscriptions are expensive and use is relatively small. There are a variety of tactics for determining how best to make journal cuts. The method used by the *Université de Montréal* is often cited as best practice (**Gagnon**, 2017). However, the large commercial publishers are masters at making cancelling titles difficult, most effectively through the "big deal". The "big deal" was never a good deal. Kenneth Frazier's 2001 predictions have all come true:

> "In the longer run, these contracts will weaken the power of librarians and consumers to influence scholarly communication systems in the future. Librarians will lose the opportunity to shape the content or quality of journal literature through the selection process. Those who follow us will face the all-or-nothing choice of paying whatever publishers want or giving up an indispensable resource. The largest publishers will not only have greater market power to dictate prices" (**Frazier**, 2001).

The first step is to get out of the "big deal" so that the library can cancel individual titles. This is a huge hurtle for many libraries. While there is much discussion about getting out of "big deals", the number of libraries doing so has been relatively small. The *SPARC Big deal cancellation tracking tool* recorded only 13 "big deal" cancellations in 2017 (*Sparc*, sf).

Once libraries can make title-by-title cancellations, tradeoffs can be made. In general, individual articles can be purchased for between $25 and $40 on the publisher's website or for slightly less from services like the *Copyright Clearance Center*'s *Get it now*. It is straight forward to calculate the cost of purchasing articles against the cost of the subscription, but it needs to be remembered that in most cases libraries do not lose access to the backfiles they have subscribed to in the past so those articles will remain available at no additional cost. Over time the value the paid for backfile will decline and more individual document purchasing will be required as the backfile ages, but at the outset, this makes a big difference in the number of articles that must be purchased on-demand.

There are some indications that the journal usage statistics (*Counter*) reported by publishers may be inflated. Ted Bergstrom analyzed *Counter* data from over 5,000 journals from the *University of California* system and found publisher-based discrepancies. As he says,

> "some publishers recording significantly more downloads than would be predicted by the characteristics of their journals… this raises the question of what causes such substantial differences across publishers once journal and discipline characteristics are accounted for" (**Bergstrom**, 2018).

Following on this work Bergstrom, Richard Uhrig and Kristin Antelman examined publisher weblogs from four publishers

that documented over 435,00 downloads. They found that often users looked at both the HTML and PDF versions of an article and there was often repeated use of the same article by the same user over several months. Bulk downloads were also included in the *Counter* totals. They conclude,

> "the *Counter* JR1 and JR5 reports conceal information on duplicate downloads that is crucial for evaluating subscriptions" (**Bergstrom**; **Uhrig**; **Antelman**, 2018, p. 7).

This may mean that for some journals use is less than we believe and replacing subscriptions with article purchase will be less expensive than expected. In addition, it is possible to limit the article purchase service to faculty or graduate students and ask others to rely on interlibrary loan. Or, all users could be presented with the choice of having the library pay $10 to $15 for an interlibrary loan that might take 24 hours or having the library pay $25 to $40 to immediate access. I suspect many users can afford to wait and will take the cheaper option.

It is important to note that moving to purchase-on-demand saves not only money that might have been spent on materials. It also saves staff time. Records for PDAs are generally batch loaded and this saves cataloging staffing that would have gone to adding records one at a time. Acquisitions staff time is also saved as most ordering can be automated. There may be some increase in interlibrary loan work, but it should be possible to automate article purchase through the library's link resolver. As will be discussed below, this staffing can be reallocated to other tasks that support inside-out library functions.

The third and fourth parts of the strategy require that more content be open access or generally available on the Web. The trick will be to recognize when this is the case and to cancel purchased items promptly. To take the easy example, how long did it take to accept that *Wikipedia* was the definitive source and cancel subscriptions to other encyclopedias. Is *PubMed Central* or *Europe PMC* an adequate source of the medical literature if you are not a medical school? How many math journals can the *ArXiv* replace? Asking these questions, especially about science and technology resources, where much of the spending is, should be done regularly.

In the *University of California*'s *Pathways to open access* report a working group drawn from across the *University of California* system review a variety of strategies for directing funds away from paywalled subscriptions and towards open access publishing (*University of California Libraries*, 2018). They review a number of approaches to open access, Green OA, APC based Gold OA, and non-APC Gold OA, and suggest strategies and their challenges and opportunities.

The particulars of a library's strategy will vary, but something like what has been outlined above is possible for everyone. What is important is to develop your particular strategy and discuss it on campus. Managing the price increases of for-profit science and technology journals should make a strong case for change, but it is equally important to talk about the need to make investments that lead to the ultimate goal. Managing the present is only half of what needs to be done, we also need to create a future that better serves our institution and scholarship at large.

Finally, these changes will be easier if there are metrics that demonstrates the library's progress in advancing its new strategy. I have suggested several, including the percentage of the library spent on on-demand purchasing and the portion of the library's budget allocated to inside-out activities versus outside-in activities (**Lewis**, 2017b). Measuring allows the library to set tangible goals and know whether or not they are being met. The strategies suggested above will be a challenge to deeply embedded past practice and without tangible and measurable goals the organizational changes necessary to implement them will be much more difficult.

3.5. Four: Support the creation of, access to, and preservation of the scholarly content created on your campus

Here I am talking about digital content. There are several things that are necessary to support an effective program. It can be built over time, but the library should have a plan for putting all of the pieces in place.

The first requirement is the technical infrastructure to manage the content. This would usually mean one or more repository systems and might mean journal or even monograph hosting systems. These resources can either be provided with local technical support on local technology or the capacity can be acquired from a service provider.

The second requirement is the human resources to support faculty and students. There are a number of roles that are useful:

- Librarians who can assist with copyright and how and where works can and should be deposited (in either local or disciplinary repositories).
- Librarians to assist with data management.
- Metadata expertise to assure that the content is discoverable.
- Expertise in digitization of all sorts of formats.
- Staff who can do much of the required work for faculty. This could be clerical staff or students.
- While not directly related, expertise in metrics, especially how faculty can use them to make cases for promotion and tenure, can be very useful.

Depending on the size of the library, the number of staff involved in these functions could be one or two, or in a larger

institution, a dozen or more. Building the staff expertise for these functions will take time and require examining how to use open positions when opportunities arise. In some cases, existing staff can be trained to take on new responsibilities. In other cases, it will be necessary to bring the expertise into the organization with new hires. But as noted above, the changes in collection building strategies should free positions that can be used to fill these needs.

The third requirement is a robust preservation strategy for digital content. The first step is good backup of servers, but more is required. Unfortunately, while some progress has been done this is still an area without good established practice. Long term preservation requires technical systems for managing bits and assuring that the bits that go into the systems are the bits that come out. This has to be done with multiple and changing formats and all of this needs to be documented with stable metadata. The institutional structures that support the technical structures also need to be robust with some assurance of longevity. Even if it is housed in a technically sound system, without long-term institutional support for content can easily be abandon, at which point it is likely lost. Finally, there needs to be a financial model that can support these functions for at least decades. Balancing financing so that it is both robust enough to assure the long-term preservation of the content and is at the same time affordable is a considerable challenge. The uncertainty of the rate of technological change is a wildcard. If Moore's Law remains in effect financial structures can be built on the assumption of cheaper storage and processing, but how certain is this over decades? Either you need to make assumptions about future costs and create an endowment to cover these costs, which is the approach taken by the *Digital Preservation Network*. Or, you trust that the library will have the long-term budget and institutional commitment to continue paying annual fees. There is always the risk that preservation organization will fail or be forced to cut corners in financially difficult times. *Lockss* succession plan is an attempt to manage these risks and is a good development (**Schonfeld**, 2018). The general point is that currently digital preservation carries inherent risks.

There are currently no obviously superior solutions. As a recent *Ithaka S+R Issue brief* states:

> "There is a significant level of confusion about the purpose and business models of existing and nascent preservation services. How do such services fit together in creating a comprehensive preservation service framework? What are the gaps and redundancies? Do they compete with each other or work towards a complementary ecosystem? How do they interact with institutional digital asset management systems? Such questions indicate that the community would benefit from a deeper understanding of the available tools vis-à-vis preservation, discovery, and access stages" (**Rieger**, 2018, pp. 8-9).

My perspective at this point is that libraries should triage the digital content to identify what is most vulnerable, either because it was born digital and the library holds the only copy or because it was digitized and the cost of digitizing it again is prohibitive. The variety of preservation options for this content should be explored and implemented. It is also important to begin to build a budget for digital preservation as it will be a crucial function for the library going forward, even if we don't fully understand how best to do it today. Remember, one of the core functions of the library is to keep documents for the long haul.

The final thing that is necessary, or at least very helpful, is to have a policy environment on campus that supports the library's efforts to capture content so that it can be made accessible, discoverable, and that it is preserved. At a minimum, thesis and dissertations should be archived by the library as a matter of policy, whether or not this work is also provided to a commercial vendor. Next, institutions should have an open access policy so there is an expectation that faculty will deposit articles and similar work in the institutional repository. There are currently nearly 100 institutions in with such policy who are members of the *Coalition of Open Access Policy Institutions* (*Coapi*), most in the United States. This is a significant group, though open access policies are far from universal. Overlaying any campus policy will be national policies such as the *National Institutes of Health Public access policy* or the coming European *Plan S*. Helping researchers negotiate these policies can be a valued serve that the library should offer.

> "Libraries should triage the digital content to identify what is most vulnerable, either because it was born digital and the library holds the only copy or because it was digitized and the cost of digitizing it again is prohibitibe"

To the extent that there are opportunities libraries should work to make open access part of campus policies relating to promotion and tenure. Today this is rare, a recent study of promotion and tenure guidelines of 129 institutions in the United States and Canada found that only 5% (six institutions) had any explicit mention of open access in their guidelines (**Alperin** *et al.*, 2018, p. 18). However, it is possible as has been shown by *Indiana University—Purdue University Indianapolis* (**Odell**; **Coates**; **Palmer**, 2016) and *Harvard's School of Engineering and Applied Sciences* (*Harvard Library*, 2014) or more forcefully at the *University of Liège* (**Rentier**, 2015).

Good policy is important, but not sufficient. Ruth Kitchin Tillman studied faculty self-deposit in institutional repositories and found that it rarely happened (**Tillman**, 2017). Clifford Lynch, who in 2003 declared institutional repositories to be "essential infrastructure for the scholarship in the digital age," has recently expressed doubt about the possibility of successful implementation of open access policies and success in giving items into institutional repositories (**Lynch**, 2003;

2017). But, as demonstrated by *University—Purdue University Indianapolis* (*Iupui*), it is possible to get substantial levels of deposits in institutional repositories. In 2017, *Iupui* reported a 70% level of deposit —1,986 articles deposited of 2,824 eligible articles (**Odell**, 2018, p. 3).

3.6. Five: Commit to the special collections your library will support and make the required investment

In the future a large part of what will make a library special, what its reputation will rest on, are the items it holds that are rare or unique. Many of these items will be the works produced by students and faculty as was discussed above. For many libraries, especially research libraries, these will also be special collections of both tangible and digital items.

Fortunately, libraries know how build these collections, it is mostly a matter of reallocating resources. Some of the savings, both money and staff, from altering the collections strategy should be directed to enhancing special collections.

To the extent possible tangible items should be digitized and records for these items should be added to national directories such as the *Digital Public Library of America*, the *Canadian National Digital Heritage Index* or *Europeana*. The advantages of doing so are clear. Everyone in the world has access to what previously required visiting a specific library, which would have been prohibitive for most people. Secondly, items in digitized collections can brought together digitally in ways that were previously impossible allowing comparison of items physically located in far flung collections. Finally, in most cases the digital copy is adequate for the user's needs and the original copy need not be consulted. This saves ware on the original tangible item. In 2013, *Ithaka S+R* and the *Association of Research Libraries* (*ARL*) conducted a study of eight particularly successful programs. Among its findings were that the ability to have access to shared infrastructure was important, that a diversity of funding sources provided greater long-term stability of projects, and that a clear understanding of how the resource will be used leads to a more valued product (**Maron**; **Pickle**, 2013).

“Some of the savings, both money and staff, from altering the collections strategy should be directed to enhancing special collections”

Since few foundations now offer grants to digitize collection, one strategy for getting collections digitized is to work with a commercial vendor to have the collection digitized in exchange for the vendor having the right to sell access for a period of time, usually ten years. The institution providing the content gets access to the digital version at no cost. The *ARL* has developed a useful set of principles to help libraries who choose this option (*ARL*, 2010).

Managing special collections in the digital environment will require the rethinking of some practices. In the past items in special collections were generally available to researchers, but putting them on the Web for the world to see is something else. As Peter B. Hirtle, Anne R. Kenney, and Judy Ruttenberg put it,

> “Collections that were once made available to scholarly researchers under the watchful eye of special collections librarians in a physical reading room can now be made readily accessible to the entire world via the Internet. Donors who were willing to allow access to materials in a controlled setting could be taken aback by the trajectory of increased access” (**Hirtle**; **Kenney**; **Ruttenberg**, 2012).

For gifts acquired in the future can be accommodated with more explicit deeds of gift, but for items donated in the past it will not always be simple. Even if the library can make a good case for their legal right to digitize and make an item available on the Web this might be inappropriate if it is clear that the donor expected more restricted access.

As is the case with preservation systems the current mix of systems that can be used in special collections and archives workflows is not integrated and the organizational capacity of the systems providers is not always robust. Work is being done in this area, but investments from libraries beyond what they currently do will be required if there is to be a full suite of integrated and adequately funded systems to support the required workflows.

3.7. Six: Infuse the curriculum with the skills necessary to create and consume information productively and ethically

The *Ithaka S+R 2015 Faculty survey* found that 54% of the U.S. faculty surveyed said that their undergraduate students possessed

> “poor skills related to locating and evaluating scholarly information.”

This was a noticeable increase from the 47% of faculty who said this in the 2012 survey. About two-thirds strongly agreed that improving their undergraduate students'

> “research skills related to locating and evaluating scholarly information”

is an important goal for the courses they teach. About half of respondents strongly agreed that

> “librarians at my college or university library contribute significantly to my students' learning” and that “librarians at my college or university library contribute significantly to my students' learning by helping them to develop their research skills.” (**Wolff-Eisenberg**; **Rod**; **Schonfeld**, 2015, p. 58).

While librarians might hope for stronger support, there is a clear understanding among many faculty that their student need better information and research skills and that librarians have a role to play in enhancing them.

In the U.S. the *ACRL Framework for Information Literacy for Higher Education* was adopted on 2016. The Framework replaced the earlier *Information Literacy Competency Standards for Higher Education* and was needed, as the *Framework* introduction states because,

> "the rapidly changing higher education environment, along with the dynamic and often uncertain information ecosystem in which all of us work and live, require new attention to be focused on foundational ideas about that ecosystem" (*ACRL*, 2016, p. 2).

The *Framework* is made up of six concepts that anchor the frames are:

- Authority is constructed and contextual
- Information creation as a process
- Information has value
- Research as inquiry
- Scholarship as conversation
- Searching as strategic exploration

As the introduction goes on the state,

> "At the heart of this *Framework* are conceptual understandings that organize many other concepts and ideas about information, research, and scholarship into a coherent whole… each library and its partners on campus will need to deploy these frames to best fit their own situation, including designing learning outcomes" (*ACRL*, 2016, p. 2).

In the U.K., using somewhat different terminology a *JISC* report, *Developing digital literacies*, states,

> "Digital literacies are those capabilities which fit an individual for living, learning and working in a digital society" (*JISC*, 2014).

Figure 3 from the *JISC* report shows the seven digital literacies.

Both the *ACRL Framework* and *JISC*'s *Digital literacies* are complex, rich and ambitious. The challenge, and it is a large one, is to marshal the library's resources so that these literacies are a significant part of the university's curriculum. Heidi Julien, Melissa Gross, and Don Latham report on a national online survey of over 600 instructional librarians they identified challenges that are familiar to anyone engaged in this work:

- A lack of time and conflicts with other job responsibilities.
- The prevalence of the "one-shot" model and lack of a structured program that builds skills through the student's career.
- Student's lack of understanding of what they don't know and are not motivated.
- Lack of understand and support from faculty.
- Lack of support from library administration.
- Difficulties with assessment (**Julien**; **Gross**; **Latham**, 2018, pp. 187-189).

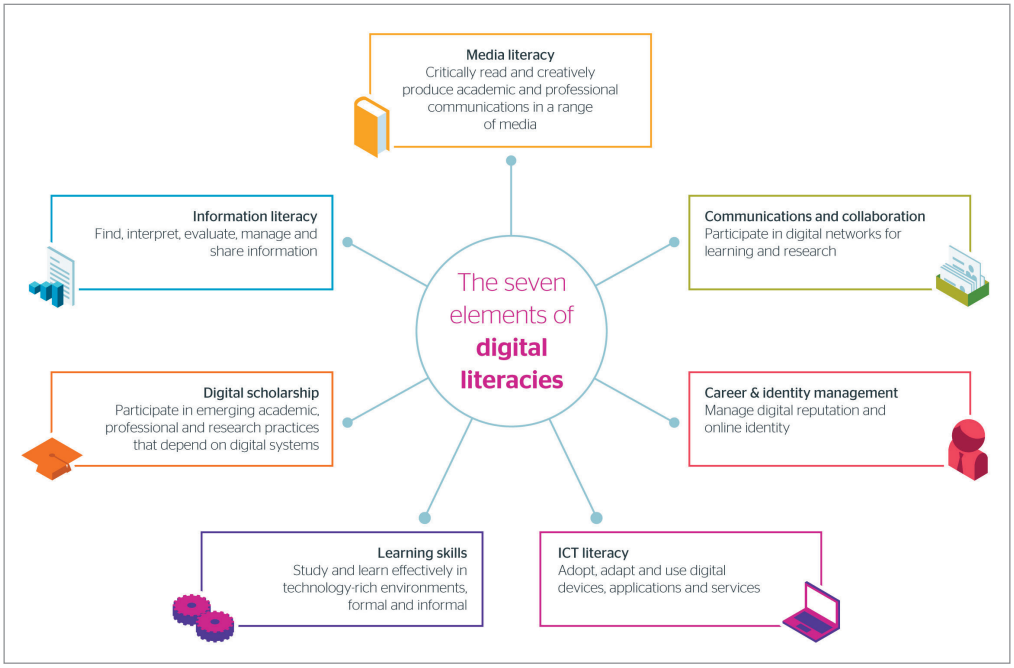


Figure 3. The seven digital literacies (*JISC*, 2014)
https://www.jisc.ac.uk/guides/developing-digital-literacies

The library literature is filled with reports of various approaches to information literacy and research skills instruction, but even the most successful rarely achieve impact across the curriculum and from the freshman experience to graduate programs. It is inevitable that individual institutions will need to allocate instruction resources to meet the most pressing needs of their campus. Most libraries have librarians who are passionate about this part of the library's mission. In my view the key is to provide support for this passion and to build a structure program across the student's academic career. It will also be important to assess the results of instructional efforts both to improve them and to demonstrate to campus administration the importance and success of this work.

3.8. Seven: Understand the demographics of your organization and have a plan to hire or develop the expertise your library will need

The simple truth is that the academic libraries will need to navigate the difficult technological and service changes that this article describes, at least at the beginning with the people they have today. You cannot wait until you have the ideal personnel in place to begin the work. Unfortunately, the people you have today will not have all the skills and expertise that are required. This will be a challenge. Opportunities to add new staff with new types of expertise will be limited and training current staff will only be able to accomplish so much.

The first thing to understand is the structural change in the type of staff in academic libraries. There has been an overall decline in staff in academic libraries. Clerical positions and the use of student workers both declined notably. At the same time there has been a modest increase in the number of librarians and a significant increase in the number of other professionals. Between 1998 and 2012, U.S. academic library staff declined by 4.7%. The number of clerical staff declined about 10% and the number of FTE student workers declined over 17%. The number of librarians increased over 7% and the number of other professionals increased nearly 50% (*National Center for Educational Statistics*). *https://nces.ed.gov/surveys/SurveyGroups.asp?Group=5*

One way to think about this is that your library will trade two clerical positions, as the work they have done is eliminated, and replace them with one professional. The cost will be about the same, but the library's headcount will decline.

The trends outlined above are likely to continue or even accelerate as digital content become predominate and labor-intensive paper content declines. Figure 4 shows this data.

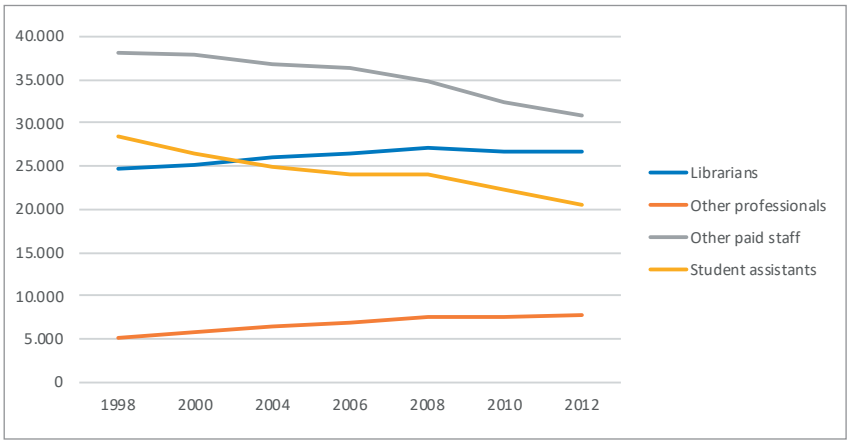


Figure 4. U.S. library workforce make-up based on *NCES* data

Kindra Orr and I have look at library staffing through the lens of generational change and described two particular challenges. We believe that:

> "Stated most simply, the challenges are:
> - Academic libraries need to exploit new technologies using new service strategies to be effective. They will need to do so with a librarian labor force that consists of a large number of baby boomers; many of whom will remain in the workforce for nearly another decade. At the same time millennium librarians, who will replace the baby boomers, need to be attracted and provided an environment that will allow them to develop and grow, and that will productively use their skills and energy. It will be important that both groups be productive and make contributions, but creating an organization with a structure and culture to do both will be difficult because in many cases aspirations and needs of the two groups will differ and be at cross-purposes.
> - As baby boomer leaders retire, Gen X and millennium leaders will need to replace them. It is unclear if there are a sufficient number of seasoned leaders in these generations. The result could easily be a large number of inexperienced new academic library leaders who will face steep learning curves" (**Lewis**; **Orr**, 2018, p. 1).

These challenges are driven by the fact that the baby boomer generation (born 1946-1964) was very large and the Generation X (born 1965-1980) was smaller. Baby boomer librarians held, and held on to, most leadership positions so that Generation X librarians could often not develop leadership experience until recently.

With the large numbers of baby boomers retiring it will be necessary to attract large numbers of millennium librarians (born 1981-2000). In my experience the pool of talented new librarians has been strong, but there are questions about the pipeline and whether traditional sources of librarians, that is library schools, will be adequate. I expect many libraries will look for the talent they need from other sources and will create positions that require expertise and credentials other than the MLS. As noted above, we can already see this happening in library staffing statistics.

Finally, there is the issue of diversity. In the U.S., academic librarians are notably whiter than the general population, the student body, and the faculty (**Lewis**, 2016, pp. 69-70). As Hui-Fen Chang documents, there has been little progress between 1980 and 2010 in diversifying academic librarianship in the U.S. (**Chang**, 2013). Unfortunately, the MLS pipeline is not much more diverse than the current population of practicing librarians (**Albertson**; **Spetka**; **Snow**, 2015, p. 93). This means increasing the diversity of the staff of any given library will be a challenge. A comprehensive study by *Mellon Foundation*/*Ithaka S+R* looked at inclusion, diversity, and equity in *ARL* libraries (**Schonfeld**; **Sweeney**, 2017). The findings where similar to other earlier studies. Interestingly the study asked library directors if there were barriers to achieving diversity and 81% said there where. This was particularly true with respect to race/ethnicity and particularly true with attracting a diverse pool of applicants. The study considered diversity at all levels of staffing and found that because non-MLS staff tended to be more diverse than librarians that pathways for these staff to enter professional positions might be an opportunity.

> In relation to diversity, in the U.S., academic librarians are notably whiter than the general population, the student body, and the faculty

All of this means that it is essential that academic libraries have a clear understanding of the demographics of their current staffing and formulate strategies to acquire the new expertise they require both through training and hiring. Academic libraries, even large ones, are relatively small organizations, and as such they have a narrow margin for error when making personnel decisions. Academic libraries also tend to make long term commitments to staff so that opportunities for hiring new staff tend to be infrequent and so bad hiring decisions have lasting impact. Moving forward without a clear understanding of their current situation and a plan for getting to where they need to be is not a good approach.

3.9. Eight: Get the culture right

So here is the situation. The library will need to change its practice and do different things that will require its staff to have new skills and expertise. Many long serving librarians will see what once made them expert professionals become unimportant. They will have to learn how to do new things. Newer and younger librarians will want to move quickly and will often find the library's usual deliberate pace of change demoralizing. Clerical staff will see that their role in the organization diminish and their numbers grow smaller. Faculty and administrators will express concern with many of the changes that need to be made. Money will be tight.

On the other hand, these are very interesting times and the work of librarians can be challenging and exciting. We are inventing libraries, actually scholarly communications, for the digital age. In many ways, there has never been a better time to be a librarian or to do library work.

The challenge for library leadership, and actually everyone in the organization, is to create a library culture where everyone works together for understood goals, where trust and respect are the norm, and where accomplishments lead to pride and celebration. This is difficult task one that will take time and effort.

There are many articles and books in the business literature that address organizational culture and managing change. The issues libraries face are not unique, and so dipping into this literature is useful for library leaders. Rather than attempting to summarize this literature, I will review my experience and make recommendations based on it.

It continues to surprise me how little time and effort most academic libraries spend on organizational development. At *Iupui*, twice a year we held a three day "organizational week" in which all staff participated. The dean would give a state of the library talk and then there would be a variety or training and/or planning activities sometimes with internal resources, but more often with the help of outside consultants. There was always a meal or two together. These activities allowed staff from different parts of the library to be together and get to know each other better. It focused on how to make the organization better and more effective. It provided the dean a regular chance to let all of the library staff know what issues the library faced and how the library was attempting to deal with them. This commitment to spend time and money on organizational development activities had clear payoffs. It led to shared sense of both the libraries goals and how we would reach them.

Many look at creating a strategic plan as the way to build and express the goals of the library and the means of achieving them. It is hard to do strategic planning quickly and without in involving lots of people. This has the advantage on engaging the library's many stakeholders, but it tends to consume the organization for one or more years. I believe that a strategic strategy, like the one laid out in my book, this article and others, is important (**Lewis**, 2007; 2016), but have come to see strategy planning as not the best use of an organizations time and energy. Planning is useful in some areas as I have suggested above, for example collections and personnel, where there are long-term commitments and large sums of money at stake. But for many areas the particulars of how best to move forward are unclear and the better approach is to experiment is small ways and learn from success and failures. Within the strategic strategy staff can use their own initiative in ways that tend to be difficult when strategies and tactics are set by a strategic plan.

It is a bit of a cliché, but I believe it is true. If you hire good people, point them in the right direction, trust their ability to do good, and accept and learn from failures, then the organization will get to where it needs to go. Stop periodically to assess how you are doing and celebrate your successes. If your organization can do this then it has the right culture.

3.10. Nine (in the book item ten): Sell the change

There are three constituencies who need to be sold on the changes the library will need to make: students, faculty, and administrators.

Students are the easiest. Given them good space and the library will be rated by students as one of the most values services on campus. Provide a good instruction program and by the time they graduate many students will come value what librarians can contribute to their educations.

The basic truth about faculty is that they have achieved their positions because they have mastered the scholarly system as it was and how it is. They live very busy lives and changing the way they do their scholarship and how they publish takes time and effort that they don't feel they have. The *Ithaka S+R 2015 Faculty survey* documents this clearly. Among the major finding of the survey were:

- "There is no observable trend towards a format transition for monographs. Faculty members' preference for using scholarly monographs in various ways in print format rather than digital format has, if anything, increased since the previous cycle of the survey.
- Faculty members prefer to be self-reliant in their data management and preservation processes… Nearly 90% of respondents organize these data on their own computer.
- Traditional scholarly incentives continue to motivate behaviors around research and its dissemination. Respondents generally believe that more recognition should be awarded for traditional research publications, such as journal articles and books… [and] are most interested in reaching scholars in their specific subdiscipline or field of research… consistent with findings with the previous cycle of the survey" (**Wolff-Eisenberg**; **Rod**; **Schonfeld**, 2015, pp. 6-7).

Jingfeng Xia conducted a meta-analysis of a several dozen studies of faculty attitudes toward open access publishing going back 20 years. He found,

> "that although an increase in the publishing and awareness rates of scholars with regard to OA journals has been observed, scholars have been consistently concerned with the low prestige of such journals and their lack of peer review, which is not the case in practice" (**Xia**, 2010).

A recent study of non-Western and non-English-specking academic authors found that 45% of the respondence to the survey had published in an open access journal, but that 9% did know what open access was (*Editage Insights*, 2018). Another recent study of contributors to Spanish scholarly journals demonstrated a general understanding of and support for open access, though there was skepticism about open peer review and altmetrics (**Segado-Boj**; **Martín-Quevedo**; **Prieto-Gutiérrez**, 2018).

I think it is fair to use an understanding of and willingness to publish in OA venues as a proxy for faculty willingness to support the changing library mission. If this is the case, we can see a slow growth of understanding and probably support, but it is far from universal. Changing faculty and attitudes and practice will be a long and slow process.

Adam Murray and Ashley Ireland surveyed U.S. provosts and chief academic officers to establish their view on the value libraries provide and the best ways for libraries to communicate that value. They concluded that,

> "Overall, provosts or chief academic officers indicate that academic libraries are involved with important campus initiatives such as student retention and success, faculty research productivity, and accreditation. They also tend to note that the biggest barrier for academic libraries to be involved with campus initiatives is that the campus overall doesn't recognize that potential."

They recommended a communications approach of library communicating,

> "evidence with provosts and other institutional administrators through means that are timely and relevant, such as a formal annual report or a dedicated budget meeting. Library administrators must strategically use endorsements from deans, directors, or other administrators, as well as user satisfaction data" (**Murray**; **Ireland**, 2018, p. 359).

Mark Robertson conducted a smaller scale study of Canadian provosts and found that they,

> "perceive libraries making significant contributions to research and student learning, particularly through the provision of access to information and the evolving role of library as place respectively. Other areas of library expertise, such as scholarly communication, appear somewhat less familiar to provosts" (**Robertson**, 2015, p. 490).

It seems that both faculty and administrators recognize that the library makes contributions to the institutions and their priorities, but that the library which may still rhetorically the "heart of the university," is really not a top priority. As noted above, faculty lead busy lives and administrators have lots of difficult problems to contend with. The important thing is that if you are going to sell the change you have to be making the change. If you have an instruction program that is well structured and you are measuring its impacts, you don't have to connect all of the dots from a library instruction session to a student's GPA (grade point average) to demonstrate the library's contribution to student success. But you will need some evidence to make the case. If you are altering your collections strategies to on-demand purchasing, the systems

you use to acquire books and journals need to work well and be fast. You can measure the citation impact of faculty authors who deposit in your institutional repository. It is also important to state the obvious, that the current system of scholarly communication, with exploitive commercial publishers extracting monopoly profits, is not sustainable. The best way to sell the change is to do it and show the impact. It will take time and there will be bumps in the road, but in the end, there are really no other choices.

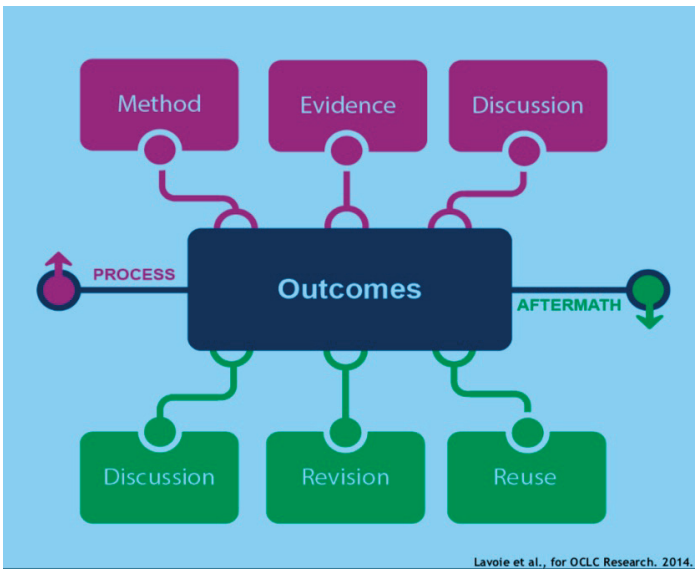


Figure 5. Evolving scholarly record (**Lavoie** *et al.*, 2014, p. 8)
https://www.oclc.org/content/dam/research/publications/library/2014/oclcresearch-evolving-scholarly-record-2014-a4.pdf

4. The most important thing to do next: Support the development and sustainability of network-level tools and services

In the time since my book was published, the thing that has become clearest to me is that while there are many challenges that individual libraries face, the biggest and most important challenge is one that we all face together as a community of libraries. To go back to Jean-Claude Guédon' description of the open scholarly commons and the what it will take to get to it. He sets out a second function after describing the library's role in curating content created on campus. He says,

> "the libraries, with their sister institutions, are involved in the task of ensuring a vibrant knowledge-nurturing life for their documents: they will circulate, be discoverable, be interoperable, be evaluated, etc., with the second function, the libraries connect to bring the knowledge infrastructure that we all really need" (**Guédon**, 2017).

Accomplishing this will be difficult because building infrastructure is difficult, and because there are large commercial entities that are attempting to capture the infrastructure of scholarly communications as they did scientific journals and use this position to extract monopoly rents from the academy, and finally because collective action is difficult.

We will begin our consideration of the infrastructure defining what outcome would be in the best interest of libraries, and more importantly science and scholarship. We will then look at the three problems listed above.

4.1. Integrated community controlled open source infrastructure

The infrastructure we need must accommodate scholarship in the digital world. In a 2014 *OCLC* Brian Lavoie and his colleagues attempted to document the evolution of the scholarly record (**Lavoie** *et al.*, 2014, p. 8). They produced the diagram shown in Figure 5.

The important point that this diagram makes is that the scholarly records, now firmly situated in the digital world, is much more complex than it was in the print-based past. The blue section in the center of the diagram represents what had been, in the paper world, the scholarly record, that part of the scholarly practice that was captured and preserved. It encompassed mostly books and articles. In the digital world it is now possible, and, Lavoie and his colleagues argue, desirable, to capture aspects of the scholarly process that take place before the traditional outcomes are produced and aspects that come after the traditional outcomes. What Lavoie and his colleagues argues is that the whole

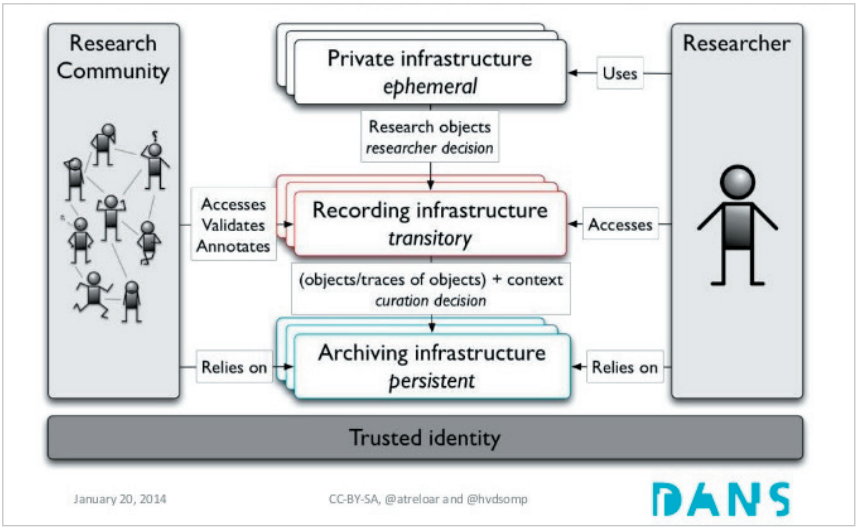


Figure 6. Infrastructure that assures reliable future access
http://www.ncdd.nl/on-line-scholarly-communications-vd-sompel-and-treloar-sketch-the-future-playing-field-of-digital-archives

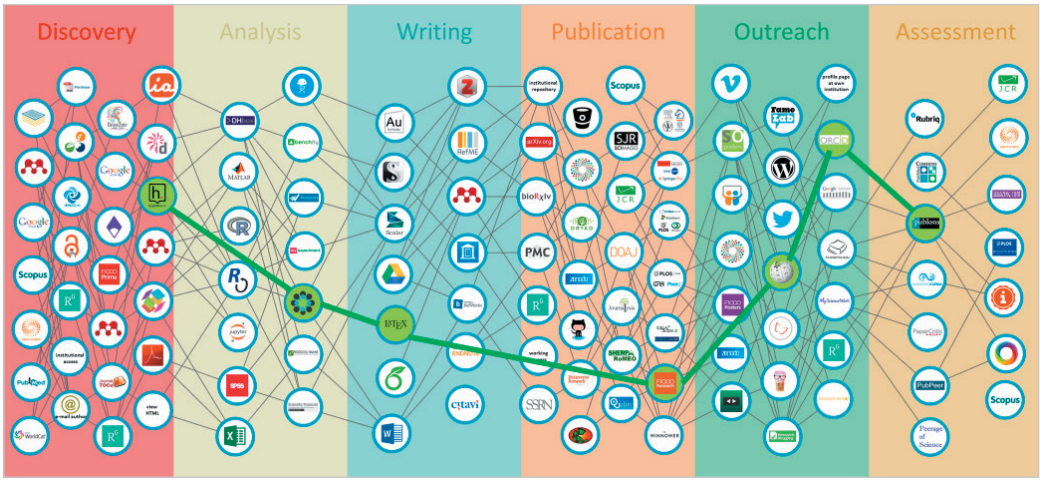
of the scholarly workflow needs to be considered part of the scholarly record.

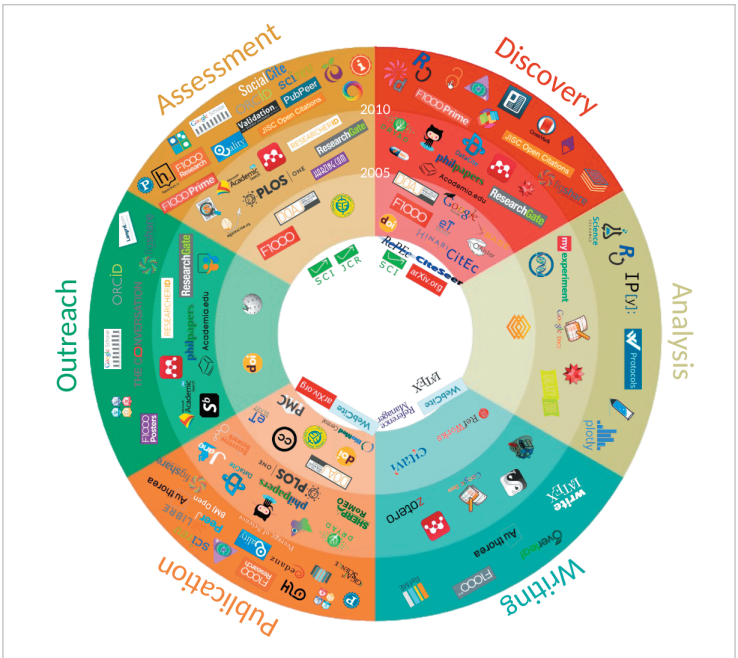
Herbert Van de Sompel looks at the digital scholarly record and makes the important distinction between three different types of infrastructure (**Van-de-Sompel**, 2014):

- Private infrastructure. This is used by the researcher to create research objects. This infrastructure and the objects created by it are ephemeral.
- Recording Infrastructure. The researcher makes the decision to move the research object into the recording infrastructure. This makes the work public and as such discoverable and accessible and through review validates the work. It may also put the work in the context of other work. This infrastructure would include roles traditionally played by publishers and libraries.
- Archiving infrastructure. Works enter the archiving infrastructure as the result of curation decisions made by publishers and/or libraries. This is the infrastructure that assures reliable future access.

Figure 6 shows a diagram illustrating this structure.

The infrastructure needed to support this more complex scholarly/scientific workflow can be shown as a linear or a circular process. Bianca Kramer and Jeroen Bosman of the *Utrecht University Library* do both from the perspective of the researcher (**Kramer**; **Bosman**, 2018). Both are shown in Figures 7 and 8.





Figures 7 and 8. Infrastructure needed to support a more complex scholarly/scientific workflow (**Kramer**; **Bosman**, 2018)
https://101innovations.wordpress.com/workflows/#MVP
https://figshare.com/articles/Views_on_innovation_The_scholarly_communication_landscape_and_changing_research_workflows_/3185293/1

A somewhat different approach is taken by Alejandro Posada and George Chen. Note that Posada and Chen include entities as well as functions, for example, open repositories and libraries, and maybe journal editorial offices (**Posada**; **Chen**, 2018, p. 6) (Figure 9).

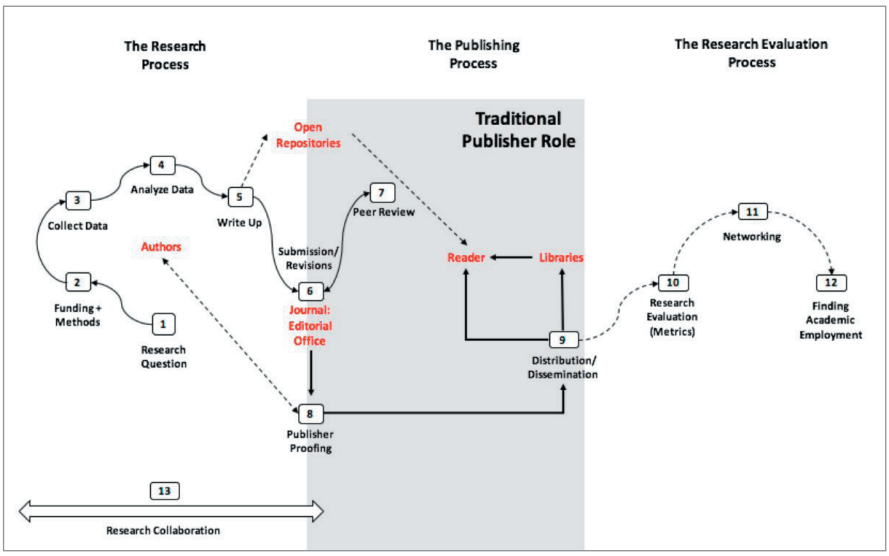


Figure 9. Academic knowledge production process (**Posada**; **Chen**, 2018, p. 6)
http://knowledgegap.org/index.php/sub-projects/rent-seeking-and-financialization-of-the-academic-publishing-industry/preliminary-findings

I would suggest that the required infrastructure, at least that part that is in the domain of academic libraries should include the functions that encompass Van de Sompel's recording and preservation infrastructure. The tools that Van de Sompel defines as private infrastructure, those use to create knowledge and that support what Lavoie and his colleagues refer to as process, are important, but are, I would argue, in the domain of academic departments, research groups and labs. It should be noted that the most significant functions that are part of the scholarly record that we have eliminated can be managed by tools that make up what Van de Sompel terms the recording infrastructure. For example, tools that facilitate discussion after publication can be used just as well prior to publication.

If we use the maps of the scholarly work flow provided by Kramer and Bosman and by Posada and Chen we get the more detail to the infrastructure tools list below. I have provided a single example in each case, for most functions there are multiple systems.

1. Research outcomes
   1.1. Repositories
      - Institutional (*DSpace*)
      - Disciplinary/Pre-print servers (*ArXiv*)
      - Content repositories (*Internet Archive*)
   1.2. Formal publishing
      - Submission and peer review systems (*xPub*)
      - Journal publishing systems (*Open Journal Systems*)
      - Book publishing systems (*Fulcrum*)
   1.3. Systems for sharing non-published items (*Figshare*)

2. Reuse and response
   2.1. Annotation systems (*Hypothes.is*)
   2.2. Discovery
      - Search systems (*DOAJ*)
      - Authority control systems (*Orcid*)
      - Personal information management (*Zotero*)
   2.3. Evaluation and assessment
      - Research profiles (*Vivo*)
      - Ranking systems (*Impact Story*)

3. Preservation systems (*Lockss*)

Having defined the functions that are necessary it is important to look at the characteristics we want in the tools and services and in the organizations that build and maintain then. Geoffrey Bilder, Jennifer Lin, and Cameron Neylon have laid out principles for defining openness of scholarly infrastructure (**Bilder**; **Lin**; **Neylon**, 2015). These principle cover governance, sustainability, and insurance and are summarized below.

- *Governance*. If an infrastructure is successful and becomes critical to the community, we need to ensure it is not co-opted by particular interest groups. Similarly, we need to ensure that any organization does not confuse serving itself with serving its stakeholders. It should be **stakeholder governed**, have n**on-discriminatory membership**, and t**ransparent operations**.
- *Sustainability*. Financial sustainability is a key element of creating trust. To be a financially stable the organization should use time limited funds in the time allotted, have a goal to generate a surplus so as to have a contingency fund

to support at least a year of operations, revenue should be mission driven and based on services, not data.

- *Insurance*. Even with the best possible governance structures, critical infrastructure can still be co-opted by a subset of stakeholders or simply drift away from the needs of the community. Long term trust requires the community to believe it retains control. Systems should be open source. Constraint with privacy laws data should be open. No patent writes should be asserted.

Bilder, Lin, and Neylon's insurance principles are similar to those proposed by Paul Peters. Peters asks how can for-profit organizations be trusted to appropriately contribute to open science. He argues that they can do so if they follow the following principles of openness:

- Open source
- Open data
- Open integrations
- Open contracts

	Community Control	Commercial
Open source and Open systems	*DSpace*	*Ubiquity*
Proprietary code and closed systems	*Contentdm*	*Bepress*

Figure 10. Openness options considering community control versus commercial, and open versus closed

The options we face can be summarized in the Figure 10. There are two dimensions: 1) community control versus commercial, and 2) open versus closed. I have put examples of repository systems in each cell.

Community control/open is clearly best. Commercial/open and community control/proprietary both have disadvantages, but are better than the final option commercial/closed. The goal of the community should be to move, to the extent possible to the upper left cell for all of the systems need to support the scholarly workflows define above.

Finally, the infrastructure needs to be integrated. Today there are many open community-controlled projects, but there is not an integrated system of tools that work well together. The work of integrating these many projects is important and there have been beginnings, especially the *Joint roadmap for open science tools* (*Jrost*): *https://jrost.org*

4.2. The nature of infrastructure and why it is so difficult

Brett M. Frishmann, in his book *Infrastructure: The social value of shared resources* defines infrastructure as follows,

> "Infrastructure resources are intermediate capital resources that serve as critical foundations for productive behavior within economic and social systems. Infrastructure resources effectively structure in-system behavior at the micro-level by providing and shaping the available opportunities of many actors."

Importantly infrastructure facilitates behaviors that affect third parties. As he puts it,

> "the *social returns* on infrastructure investment and use may exceed the *private returns* because society realizes benefits above and beyond those realized by producers and user. [italics in the original]" (**Frischmann**, 2012, pp. 11-21).

Frischmann makes the obvious but important observation that, both governments and markets struggle to adequately supply the public with the infrastructures that it needs. There are good reasons for this. First, infrastructure is often expensive to build and maintain, and raising the necessary capital can be difficult. It is also the case that the nature of the benefits that infrastructure makes possible are not always easily identified and often the impact on any one individual is small. This makes the social value of infrastructure difficult to fully appreciated. Without this concrete sense of the return, investment is often difficult to justify.

Governments are often involved in the provision of infrastructure because governments are able to assess taxes and use them to fund infrastructure without being dependent on the reliably expected returns that the market requires. If is often not this simple, but taxing for the public good is often the best place to start in funding infrastructure.

Frischmann identifies three criteria that infrastructure must meet from a system perspective.

- The resources may be consumed nonrivalrously for some appreciable range of demand.
- Social demand for the resource is driven primarily by downstream productive activity that requires the resource as an input.
- The resource may be used as an input into a wide range of goods and services, which may include private goods, public goods, and social goods. (**Frischmann**, 2012, p. xiv).

The first criterion requires nonrivalrous consumption, though not over all levels of demand. Nonrivalrous use means that one person's use does not interfere with the use of another person. Ideas are nonrivalrous, so is air or a road or library, though a library or a road are subject to congestion at high level of use and air is subject to uses by some that degrade its usability for others.

The second criterion makes clear that infrastructure is a means to an end not the end itself. The value of infrastructure is in what it makes possible. Often what it makes possible happens indirectly. This is why the value of infrastructure is not always fully appreciated. Its full value is hard to observe.

Finally, the use of infrastructure can provide benefits across a variety of activities. Infrastructure is a shared means to many ends. Some of those benefits accrue to society at large and some are captured by individuals. Either is acceptable. As Frischmann says,

> "The key insights from this analysis are that infrastructure resources are basic inputs into a wide variety of productive activities and infrastructure users who choose to engage in such activities often produce public and social goods that generate spillovers that benefit society as a whole" (**Frischmann**, 2012, p. xii).

Because infrastructure enables nonrivalrous use of a resource, the widest possible access to the resource with the fewest impediments to use will maximize the value of the infrastructure resource to society. Libraries and most other involved with scholarship espouse this goal, but the structures that have evolved as scholarship has become digital often restrict access rather than encouraging unfettered access, thus limiting the value of the work.

From an economic perspective infrastructure is most often either a natural monopoly or a public good. Except when congestion occurs at high levels of demand the more an infrastructure is used the better, as this creates the most benefit. This is typical done by charging users the marginal cost. For both natural monopolies and public goods, the average costs decrease as output increase and marginal costs are below average costs. Efficient price thus precludes the investors recouping all of the costs. Because infrastructure often requires substantial investments the difference between average and marginal costs can be significant. This is a problem. It is generally solved in one of four ways: government provision; government subsidy; nonprofit or community-based provision, or market provisions that allow providers to charge more than the marginal cost.

So, the reasons that infrastructure in general is difficult are:

- There is often a very high initial cost.
- Many of the benefits of infrastructure accrue to individuals, firms, and to society at large, making the measurement of impact difficult. They often also accrue indirectly and long after the actual use. The value of infrastructure is thus had to assess, and is therefore not always appreciated as it should be. This makes raising the funds required to build and maintain infrastructure difficult.
- The economics of infrastructure, as a natural monopoly or a public good, means that the most benefit is generated when marginal cost is charged for use. Returns from margin cost pricing will not often cover the cost of the initial investment. This generally means some form of tax or philanthropy is required to fund the start-up costs for infrastructure and often its maintenance.

All of this makes infrastructure in general difficult. All of these problems apply as we try to create the infrastructure we need to support the open scholarly commons.

4.3. The commercial competition

We already have a clear understand that the scholarly journal market is an oligopoly. Vincent Larivière, Stefanie Haustein, and Philippe Mongeon document the extent of the consolidation in scholarly journal publishing (**Larivière**; **Haustein**; **Mongeon**, 2015). They look at the Natural and Medical Sciences (NMS) and Social Sciences and Humanities (SSH). In NMS the top publishers were *Reed-Elsevier*, *Wiley-Blackwell*, *Springer*, *Taylor & Francis* and the *American Chemical Society*. In SSH the top five were *Reed-Elsevier*, *Wiley-Blackwell*, *Springer*, *Taylor & Francis*, and *Sage*. In NMS the top five publishers accounted for a little more than 20% of the papers in 1973. Their share increased to 30% in 1996; passed 50% in 2006, and was 53% in 2013. *Reed-Elsevier*, *Wiley-Blackwell*, and *Springer* accounted for 47% of all NMS papers in 2013. In SSH the top five publishers accounted for about 10% of the papers between 1973 and 1990, but by 2013 their share of papers had increased to 51%. This consolidation fortified the "big deal" strategy of the publishers and made it more difficult for libraries to withdraw from them. This in turn has led to excessive price increases and profits for these publishers that are widely reported as being between 35% and 40%. This is well above profit margins in most other industries.

As Jonathan Tennant and Björn Brem put it in the conclusion of the complaint against *RELX* (*Elsevier*'s parent company) to the *EU Competition Authority*:

> "We believe that the present scholarly communication market is clearly not functioning well due to a number of related reasons. High subscription charges still reign, publishers still offer limited access to research to the wider public, many continue to reap excessively high profits, and many financial elements of the process is shrouded in secrecy. Much of these peculiarities exist due to a combination of content aggregation and concentration by a few large players, chief among which is *Elsevier*, that each individual research article acts as a mini-monopoly meaning that consumers have no buyer power over content, and the use of non-disclosure clauses over licensing agreements which restricts any sort of competitive consumer power" (**Tennant**; **Brems**, 2018).

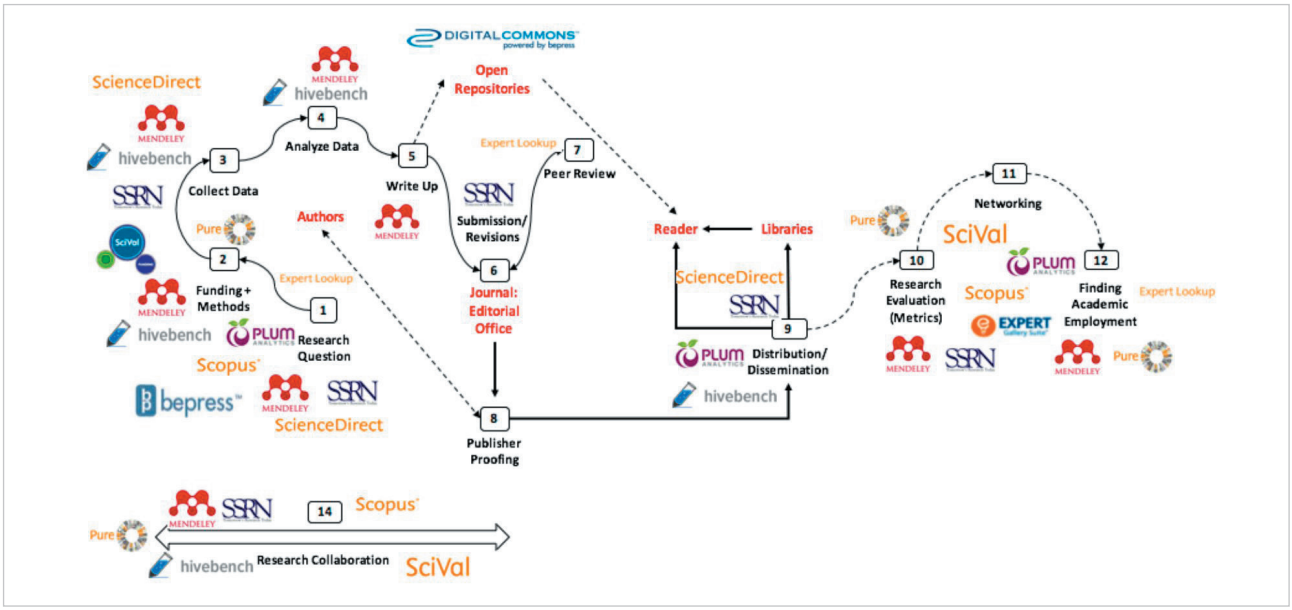


Figure 11. *Elsevier* acquisitions on a version of the scholarly workflow (**Posada**; **Chen**, 2018, p. 6)

What is especially concerning is that these powerful players are now looking to assert control of academic workflows and educational processes beyond journal content. The purchase of *Bepress* by *Elsevier* in the summer of 2017 was a stark reminder to the library community that its infrastructure was vulnerable to acquisition. This should not have been a surprise. As Posada and Chen have documented, *Elsevier* has pursued a clear strategy of acquiring infrastructure components across the scholarly workflow. The *Elsevier* strategy is clearly seen in Figure 11 that overlays *Elsevier* acquisitions on a version of the scholarly workflow (**Posada**; **Chen**, 2018, p. 6).

Posada and Chen summarize the situation we find ourselves in:

> "As major academic publishers' have redirected their business strategies to open access and alternative paying structures, it could be argued that this represents a move towards more democratic access to knowledge. However, this paper problematizes this claim by documenting and examining what has been a simultaneous redirection of big publishers' business strategy towards the acquisition and integration of scholarly infrastructure, the tools and services that underpin the scholarly research life cycle, many of which are geared towards data analytics. We argue that moves toward openness and increased control of scholarly infrastructure are simultaneous processes of rent-seeking which could further entrench publishers' power and exacerbate the vulnerability of already marginalized researchers and institutions" (**Posada**; **Chen**, 2018, p. 1).

They go on to argues that *Elsevier* is pursuing the research work flow beginning to end and that *Wiley* is attempting to lockdown online/digital education. In both cases the aim is not just to control the infrastructure, but to harvest and have monopoly control of the data that the infrastructure generates. Should *Elsevier* or *Wiley* or one of the other large companies in this space —*Springer/Nature*, *Clarivate Analytics*, *Academic Analytics*, *Pearson*, *McGraw-Hill*, or *Cengage*- come to control a large segment of either the research workflow or online/digital education, they would know more about the university's business than the university. Think for a minute about the research workflow. If a single business controls a large enough segment of this workflow across a large enough number of institutions, it has a unique, privately held, understanding of where science is going, what discoveries are being made, and where money might be made as a result.

Tim Wu examines information industries in his book *The master switch* (**Wu**, 2010). He argues that information industries, as is the case with scholarly communication, evolve toward oligopoly and monopoly. That once they gain control of a market, they lock in the revenue streams, resist change, and build barriers to new entrants in the market place. Wu documents this evolution with the telegraph, radio, telephones, television, and the Internet. He concludes that only regulatory action by governments alter the situation. The action can be either regulatory control, as was the case with *AT&T* in the United States in the first half of the 20th century, or breaking up the monopoly enterprise, as was the case with *AT&T* in the 1980s.

Despite some modest attempts to make publicly funded research openly available, for example the *U.S. National Institutes of Health* public access policy, the large publishers have been effective in lobbying governments on both sides of the Atlantic to stop any alteration of their practices. *Plan S* can be seen as the most robust attempt to date to regulate the commercial publisher's monopolistic behavior. It will be interesting to see how successful *Plan S* will be given the inevitable push back from the publishers and their lobbyists. We can hope that because most to the money that funds the commercial publisher's excess profits comes from governments, that these government will at some point respond to this exploitation, but we will have to wait and see.
https://www.scienceeurope.org/making-open-access-a-reality-by-2020

4.4. The collective action problem

It is not enough to wait for government intervention on our behalf, libraries need to build our own community-controlled infrastructure so that here is an alternative to what the large commercial players provide. As we noted at the beginning, there are forces that are working in our favor, the power of technology is increasing and the cost is declining, the nature of digital content works in our favor, and much of the money in the system passes through our hands. However, to take advantage of these forces we need to solve a very difficult problem. We need to overcome the collective action problem. We need to develop the capacity to act collectively to create and nurture a public good.

In 1965 Mancur Olson published *The logic of collective action* in which he laid out what has become known as the collective action problem (**Olson**, 1965). Olson argued that groups have a difficult time providing themselves with collective goods, even when the provision of such goods would greatly advantage the group. He argues that in some cases small groups will be able to do so, but that large groups can almost never do so without some form of compulsion or the ability to provide individual members of the group some unrelated benefit. This is because the cost of coordinating collective action and, with large groups, a single individual's contribution is small and individuals can generally benefit whether or not they contribute.

As Clay Shirky, in his book *Here comes everybody* (**Shirky**, 2008), and Yochai Benkler, in his book *The wealth of networks* (**Benkler**, 2006), powerfully demonstrate the Internet has radically reduced coordination costs to the extent that, for example, a group can collectively create an encyclopedia. None-the-less, the collective action problem remains as the incentives for members of large groups to contribute remain weak. The inability of academic libraries to make the collective investment required to create the infrastructure we need is a key problem that we need to face and to solve.

John Wenzler examines the collective action problem academic libraries face and summarizes the situation well:

> "Economists and political scientists long have argued that it is extremely difficult to replace the unconscious coordination made possible by market transactions with the conscious coordination required for collective action. Even when everyone involved understands and desires the benefits of cooperation, it is often impossible for them to work together to achieve it... Because everyone benefits from the creation of public good regardless of whether or not they help to produce it, individuals are tempted to become "free riders" who exploit the efforts of others. Even those who have no intention of free-riding for themselves are reluctant to invest in a public good because they worry that their effort will be wasted if too many other people chose to ride for free. In small communities, it often is possible to build bonds of reciprocal trust that allow groups to achieve collective ends, but it is more challenging for larger and more distributed groups to do so" (**Wenzler**, 2017, pp. 184-185).

Wenzler argues that it is this collective action problem that has made it impossible for the academic library community to benefit from digital technologies that should make scholarly communication, as was described above, cheaper and more easily available to all of the people who wish to use it. Because we have not overcome the collective action problem, we face continued steep price increases from for-profit publishers who maintain monopolistic control over much of the scholarly communications system. Wenzler is frank about our prospects:

> "Although it is likely that university libraries could develop a more efficient system of scholarly communication if they were to redeploy their collective subscription budgets, each individual library —when it decides how to spend its own little piece of that huge pie- has little incentive to redirect its own expenditures... Unfortunately, if every librarian waits for every other librarian to make the investments necessary to develop a sustainable system of Gold OA publishing, it may never happen" (**Wenzler**, 2017, p. 192).

Wenzler's critique clearly defines the problem we face, but it is incomplete. Cameron Neylon also uses Olson's work to consider the collective action problem faced by the scholarly community (2017). He notes that Olson argues there are three ways to solve the provisioning problem presented by public goods. They are:

- Mechanisms that require contributions from the whole community. Taxation is the clearest example. For scholarly infrastructure, such mechanisms include indirect cost taken by institutions and top-slicing of funder budgets to provide infrastructure and services.
- Mechanisms that provide additional private good or services to contributors. This approach is generally referred to as a club good. It requires the creation of a good or service that is non-rivalrous but excludable. Neylon cites *Crossref* as an example. Contributors gain the exclusive right to mint DOIs and the broader community gain an open database of scholarly content. For much of scholarly infrastructure creating club goods can be problematic. As Neylon says,

  > "Digital resources are not natively excludable; a technical barrier has to be put in place" (**Neylon**, 2017, p. 2).

  This is both a technical and a philosophical problem.
- Reducing the size of the group to the extent that all of the members can agree that contributions are in their interest. Such oligopolies for scholarly infrastructure are likely to be either groups of large funders or governments. Neylon cites *Europe PubMed Central* as an example. Importantly, Neylon notes that oligopoly among funders can look like taxation to the individual researcher. Thus we see the "academic freedom" response to *Plan S*.

The effectiveness of the various strategies depends on the size of the group attempting to create the public good. Neylon makes the critical point,

> "The difficult truth that Olson articulates is that there is no mechanism that will lead directly to a large community supporting the provision of a large-scale public-good infrastructure. Any successful sustainability model will depend on some mixture of these three approaches for resourcing."

He goes on to state,

> "If our challenge in delivering on the openness and transparency agenda is how to support the conversion of successful medium-scale club-like infrastructures into open systems that provide collective goods, then we need to solve the political and economic problems of transitioning from the club state to a model that successfully provides a mix of these models" (**Neylon**, 2017, p. 3).

To the extent that academic libraries act in isolation, they will inevitably act in their own narrow interest and we will not be able to create the infrastructure that will be required to support the open scholarly commons. This is Wenzler's point, and it is important. Neylon provides a more nuanced view that argues for the need to look at the political economy of scholarly infrastructure and consider governance and community building as well as financial sustainability if we are to successful create the institutional structures required to support scholarly infrastructure, Neylon argues, we may be able to find the necessary resources.

Elinor Ostrom won the Nobel Prize in Economics for her work on commons governance. Her book, *Governing the commons: The evolution of institutions for collective action*, examines situations and institutions where commons are successful (1990). Her work demonstrates that the collective action problem though real, can be overcome given the right circumstances, incentives, and motivations. Her work can provide both hope and guidance.

Ostrom looks at a variety of common pool resources (CPRs) and develops design principles form this study. Her work was with physical systems such as forests, fisheries, or irrigation systems. These systems require mechanisms both provisioning (the work require to create and maintain the systems) and appropriation (managing how the resource is used).

The commons we are endeavoring to create is digital and networked and as we have observed, digital content can be distributed for all practical purposes at no cost. This means that the open scholarly commons do not need to be concerned with appropriation, as use does not diminish the resource. Once provisioning is accomplished, that is once the resource is created and there is a mechanism for ongoing maintenance and enhancement, the commons can function. So, provisioning the open scholarly commons is what we have to accomplish. This simplifies the task, but it is still significant. Ostrom states the challenge:

> "Designing and adopting new institutions to solve CPR problems are difficult tasks, no matter how homogeneous the group, how well informed the members are about the conditions of their CPR, and how deeply ingrained are generalized norms of reciprocity. Given the strong temptation to shirk, free-ride, and generally act opportunistically that usually are present when individuals face CPR problems, overcoming such problems can never be assured. No strong external pressures drive individuals toward positive solutions to such problems" (**Ostrom**, 1990, pp. 210-211).

Ostrom suggests that success in creating a CPR is best when the follow conditions exist:

- Parties share a common judgement that they will be harmed if they do not adopt an alternative arrangement.
- Parties will be affected in similar ways by the proposed arrangement.
- Parties highly value the activities from the common pool resources (CPR), they have low discount rates.
- Parties face relatively low information, transformation, and enforcement costs.
- Parties share norms of reciprocity and trust that can be used as initial social capital.
- The group is relatively small and stable (**Ostrom**, 1990, p. 211).

When we look at the current state of academic libraries and scholarly communication in light of Ostrom's work we see that there are some positives and some negatives.

1. Parties share a common judgement that they will be harmed if they do not adopt an alternative arrangement. This is a big plus. We understand the system's problems and the harm that is being done. We know we should act.

> "Libraries have to reshape themselves so that they are nodes on the global network that will make up the open scholarly commons"

2. Parties will be affected in similar ways by the proposed arrangement. This is a minus. At the present time, there is no shared understanding of what the system we are trying to create should be. There is no roadmap. There is probably general agreement, but agreement on strategies and tactics to construct the system are not widely understood or accepted. Nor do we know what resources individual libraries are now committing to activities that support the creation of the open scholarly commons. Because we don't know what others in our community are doing there are no norms to guide behavior. Creating a general understanding on levels of contribution and developing norms is the aim of the 2.5% commitment initiative, but this work is in its infancy (**Lewis**, 2017c).

3. Parties highly value the activities from the CPR, they have low discount rates. This is a plus. The academic library community's default is to share. Having a low discount rate means that the future value of the resource declines slowly. Libraries by their nature have long time horizons and so our discount rates are general low.

4. Parties face relatively low information, transformation, and enforcement costs. It is hard to know what the information costs will be, but it is likely that they will be relatively low as there are many existing structures to expedite them. The academic library community tends to be overly deliberative, which increases coordination costs.

> "Libraries have to create and sustain the infrastructure that will support the open scholarly commons"

5. Parties share norms of reciprocity and trust that can be used as initial social capital. Probably a plus. In general, academic libraries share norms of reciprocity and trust that can be used as initial social capital. Although trust is highest in small groups and in most cases the level of investment is small so the risks of trust are small. To generate trust across the system, it will be necessary for organizations providing systems and services to be exceptional transparent in the ways proposed by **Bilder**, **Lin**, and **Neylon** (2015) and use open contracts as proposed by **Peters** (2017).

6. The group is relatively small and stable. This is a minus. Academic libraries as a whole are a very large and diverse group, and the system we are attempting to create is global.

When we look at the conditions Ostrom sets for the successful creation of a CPR, our problems are clear. However, it may be that the scale of the threat and the need response will motivate the library community. Ostrom's work suggests the need leverage small scale collaborations and build hierarchical structures on them to support global scale work. It argues for the necessity of transparent governance and finances in order to build trust, and the development of shared values, in my view, especially around appropriate resource contributions to the commons. We also need to make the landscape and the roadmap forward clear as a means of developing a shared understanding of what needs to be accomplished and how it will be done. If we can do these things, Ostrom's work provides a reason for hope.

5. Conclusion

So, there is much work to do. Some of it will be in reshaping our individual libraries so that they are nodes on the global network that will make up the open scholarly commons. I believe this is the easier half of what needs to be done. We will need new skills and expertise, but the work is an extension of what libraries have done for a long time. It will be both challenging and exciting. The second half of our work is to create and sustain the infrastructure that will support the open scholarly commons. This infrastructure will need to be integrated and community controlled. It will require ongoing financial contributions from universities and governments. A sizeable portion of this funding will come the reallocation of library budgets.

> "If we do not build and maintain infrastructures as a public good, the private sector will build it and use it to extort excessive profits fron our institution and the inequities of access to the scholarly record will continue"

If we do not build and maintain this infrastructure as a public good, the private sector will build it and use it to extort excessive profits from our institutions and the inequities of access to the scholarly record will continue. These inequities are of two types. First those who could benefit from the knowledge and cannot afford to acquire it. Second, those, largely from the Global South, who do not have access to the venues that would bring their research to the world.

The challenge is clear. It will not be easy. But I am optimistic. We get to create something new, something that was not possible before. Because nature of the network and digital information on it, we have the tools to create the open scholarly commons where the world's knowledge openly and easily available to everyone. What could be more important?

Note

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